



Knowledge management and information technologies: a conceptual model for supply chain integration

Gastélum-Valdez, Jesús Sigifredo¹[0000-0003-1084-893X] and Espitia Moreno, Irma Cristina²[0000-0001-7571-2692]

¹ Universidad Latina de América, Morelia Mich. 58188, México.

² Universidad Michoacana de San Nicolás de Hidalgo, Morelia Mich. 58000, México
jsgastelum@unla.edu.mx

Abstract. The purpose of this article is to build a supply chain integration conceptual model using the knowledge management and information technologies as a resource of a firm and how these attributes influence the supply chain integration. A structured literature review was used to identify the relationship of information technologies and knowledge management and supply chain integration. With the literature review a conceptual model was developed, in the model supply chain integration is influenced by creation, transference and execution of knowledge and IT ease of use, IT compatibility and IT utility and the effects are moderated by organizational, logistics and information integration. The model developed can become a guideline for firms with weak supply chain integration and want to increase their relationship with customers and suppliers.

Keywords: Supply chain integration, firm resources, knowledge management, information technologies

Introduction

A major change in the paradigm of modern business is that companies no longer compete on an individual basis, but now compete as supply chains (Lambert et al., 1998). Considering this situation, the study on supply chain has become one of the main topics between corporate executives and academics have found in recent years, the changes that have come forward to compete in global markets have made relations between firms more complex so the supply chain integration in the industrial environment is key to the success of companies.

The competitive pressures have direct effects in the supply chain and his integration. The integration of activities inside and outside the company has become a major challenge for executives and academics of the supply chain (Carter et al., 2009). To explain this situation, the resource-based approach could help to explain why some supply chains outperform others and gain sustained competitive advantage (Barney, 1991). Nevertheless, since the introduction of the resource-based view of the firm in the strategic management literature (Wernerfelt, 1984; Barney, 1991) the framework has been rarely used in supply chain integration literature.



The supply chain integration seeks to reduce the barriers that prevent the coordination, control and communication of the processes of the different firms within a supply chain (Kaufman, 1997). With the supply chain integration, a predominant aspect is the belief that by integrating the supply chain the firms will improve their competitive position (Lambert et al., 1998; Frohlich and Westbrook, 2001; Bagchi and Skjoett-Larsen, 2002), it has positive effects on the individual performance of the firms (Bagchi and Chun Ha, 2005; Van der Vaart and Van Donk, 2008), while others have a positive impact on the performance of the supply chain (Narasimhan and Kim, 2002; Lee et al., 2007).

In this research proposes a supply chain integration model using knowledge management and information technologies as a strategical resource of the firms and how these resources could help to integrate supply chains. To achieve this goal this research is divided in to the following sections, the second section presents the model components, the third section shows result discussion and section 4 conclusions.

2. The model components

2.1. Supply chain integration (SCI)

The supply chain integration activity began in the 80 when the client-supplier relationships were created, these relationships were attributed to three factors (Awad and Nassar, 2009): (1) the manufacturing activity is made in a global context, where the local markets are subjects to global standards. (2) constant stress influences the organizational structure and manufacturing activities. (3) the development of products and production systems environmentally benign.

On the other hand, Handfield and Nichols (1999, p. 5) mention that the revolutions of information and communication technologies, the growth of the global competence levels, and the development of new inter-organizational relationships, have caused that supply chain integration. Factors like collaboration, trust, information sharing, and similar technologies have caused the firms to be individual entities to become chains of integrated processes (Akkermans et al., 1999; Power, 2005).

In the literature exists different definitions of supply chain integration, Flynn et al. (2010, p.59) define it as "the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages Intra and inter-organization processes. The goal is to achieve effective and efficient flows of products and services, information, money, and decisions, to provide maximum value to the customer at low cost and high speed". Another definition of supply chain integration is "a strategic tool, which attempts to minimize the operating cost and thereby enhancing values for the stack-holders (customers and shareholders) by linking all participating players throughout the system; from supplier's suppliers to the costumers" (Kwon & Suh, 2005, p. 26).



The above definitions emphasize that to achieve an integration of the supply chain, inter and intra-firm collaboration is fundamental so that the individual efforts are added up to achieve optimal functioning of the supply chain. Additionally, developing a conceptual definition of the supply chain integration will help to understand better, the theories, their indicators, the implications in administrative matters, as well as their academic importance (Fabbe-Costes & Jahre, 2008; Chen et al., 2009; Zhang & Huo, 2013).

2.2. Knowledge Management and SCI

In their article Hult et al. (2004), suggest that the management of the supply chain involves facilities and activities that transcend the firm boundaries, and they argue that firms that are better able to create and use the supply chain knowledge should outperform others (Barney, 1991).

Previously to develop knowledge in supply chains, achieved memory, knowledge acquisition activities, information distribution activities, and shared meanings affect positively the outcomes of the firms. Also, knowledge development may enhance supply chain outcomes. In the same logic knowledge is an important source of coordination and thus be central to the organization's functioning (Hansen, 2002; Hult et al., 2004).

Academics have identified that knowledge-based dimensions represent an important gap in the supply chain management field (Croom et al., 2000), these gaps also represent an important opportunity. So, knowledge development in the firm is the key to achieving superior supply chain performance (Hult et al., 2005).

To understand the knowledge importance in supply chains was developed by Done (2011, p. 5), he develops a three phases framework to unify and integrate knowledge in a supply chain. Phase 1, vicarious learning leads to knowledge transfer from supply chain transfers. Phase 2, continued experiential learning, leads to the upgrading of the knowledge and develop supply chain competence. And, phase 3, internal exploitation/external exploration knowledge balance, where the seeks to combat potential diminishing returns and performance in the long term.

Within the knowledge creation phase in the supply chain, the empirical literature review shows that knowledge creation includes an improved firm image, employees' satisfaction and client satisfaction (Coulson-Thomas, 2004). Also, the supply chain members have to be committed to interconnected processes to share information and build infrastructure aimed to create new knowledge (Malhotra et al., 2005).

Regarding the knowledge stored in the supply chain, Walsh and Unsong (1991) mention that there are five repositories of knowledge, the individual, the culture, formal procedures and systems, structures, and external activities. The empirical results demonstrated that a strategic orientation towards knowledge, a culture of learning and



practices related to the firm's human resources have direct effects on the retention of knowledge in the firms (Nelson and McCann, 2010). Kong et al. (2011) suggest that the human resources department of organizations along with practices related to innovation and learning play an important role in the storage of knowledge.

In terms of the transfer and exploitation of knowledge with a focus on the supply chain, the management of information, materials and financial flows becomes knowledge that can be used to optimize the supply chain integration (Hadaya and Cassivi, 2009). Other authors mention that if the information is properly contextualized and the member of a supply chain know how to react to the information received, we speak of a knowledge transfer and the firms can extend their intra-firm processes to an inter-firm process (Ke and Wei, 2007; Hadaya and Cassivi, 2009). It can be considered a knowledge transfer in the supply chain when "the transfer of knowledge allows the members to orchestrate the operation of the supply chain and obtain positions of competitive advantages. The lack of knowledge transfers has been consistently found as the fundamental failure factor in the supply chain management" (Ke and Wei, p. 207, 2007).

2.3. Information technologies and supply chain integration

The use of information technologies (IT) within supply chains has been increasing with the development of integrated IT, their use began in the early eighties mainly in terms of software, hardware, and connectivity. They mention that the IT that have been used are: bar codes in logistics systems, the use of electronic data interchange (EDI), use of material requirement planning (MRP), a business solution such as enterprise resource planning (ERP), the internet and web services for communication between members of the supply chain (Miraz et al., 2016).

In this sense, Simichi Levi et al. (2003) mention that the basic objectives of IT within the supply chain are: to provide information and visibility, provide a single point of information contact, and make decisions based on the total information of the supply chain and facilitate collaboration with the other members of the supply chain.

Competitive advantages can be reflected in the supply chain, Levary (2000) suggest that IT in the supply chain provides a reduction of time, inventories, minimization of the whip effect and improvement of the effectiveness of distribution channels. Prajogo and Olhager (2012) highlight three benefits: (1) IT allows firms to increase the volume and complexity of the information that needs to be communicated among members; (2) IT allows firms to provide important information in real-time for members, such inventory levels, delivery status and production planning, permitting firms to manage and control their activities in the supply chain; (3) IT facilitate the alignment of forecast and scheduling operations between firms improving inter-firm coordination.



Regarding the effects of the relationship between IT and supply chain integration, Prajogo and Olhager (2012) found that the technological capabilities of the firm related to IT and the information sharing through them have important effects on the operational integration of the supply chain. About operational integration of the supply chain, the use of IT for the information exchange is essential to achieve a supply chain integration and benefits of this process (Vanpoucke et al., 2017).

3. Model building

Supply chain integration seeks to reduce the barriers that prevent the coordination, control and communication of the processes of the different firms within a supply chain (Kaufman, 1997). With the supply chain integration, a predominant aspect is a belief that by integrating the supply chain the firms will improve their competitive position (Lambert et al., 1998; Frohlich and Westbrook, 2001; Bagchi and Skjoett-Larsen, 2002), it has positive effects on the individual performance of the firms (Bagchi and Chun Ha, 2005; Van der Vaart and Van Donk, 2008), while others have a positive impact on the performance of the supply chain (Narasimhan and Kim, 2002; Lee et al., 2007).

The benefits related to the integration of the supply chain are observed in a reduction of costs and an increase in the value of the focal firm, its shareholders and members of the supply chain (Lee, 2000). The interaction of the supply chain involves a set of planned investments in the construction of long-term relationships and the standardization of processes, which creates a complex network, this relationship is difficult to imitate by the other supply chains (Koufteros, et al., 2010; Chen et al., 2009). In addition, capacities are created that are difficult to imitate and that is worked in a synchronized and close way, and specific knowledge is shared (Blome et al., 2014; Schoenerr and Swink, 2012; Rosenszweig et al., 2003), which increases efficiency and coordination of the supply chain (De Vita et al., 2011).

The conceptual model developed in this research, the following components were identified: the first component is knowledge creation (Hult et al., 2004; Craighead et al., 2009; Croom et al., 2000), knowledge storage (Walsh and Unsong, 1991; Nelson and McCann, 2010), knowledge transfer (Hadaya and Cassivi, 2009; Ke and Wei, 2007) and knowledge execution (Done, 2011).

The second component was considered information and communication technologies, where IT usefulness factors are identified (Simichi Levi et al., 2003, Narasimhan and Kim, 2001), IT compatibility (Prajogo and Olhager, 2012) and IT ease of use (Cai et al., 2016).

All of the above components influence information integration (Rai et al., 2006; Bar-rat y Oke, 2007; Caridi et al., 2014), the logistics integration (Stock and Boyer, 2009;

Rai et al., 2006) and the organizational integration (Flynn et al., 2010; Cousins and Mengue, 2006; Hines and McGowan, 2005).

The conceptual model developed proposes that the compatibility, ease of use and usefulness of IT positively influence the use of IT in the supply chain. Likewise, information technologies have a positive influence on knowledge chain. Likewise, information technologies have a positive influence on knowledge management and both influence the integration of information, organizational integration and the integration of information. Finally, these three elements influence the integration of the supply chain as figure 1 shows.

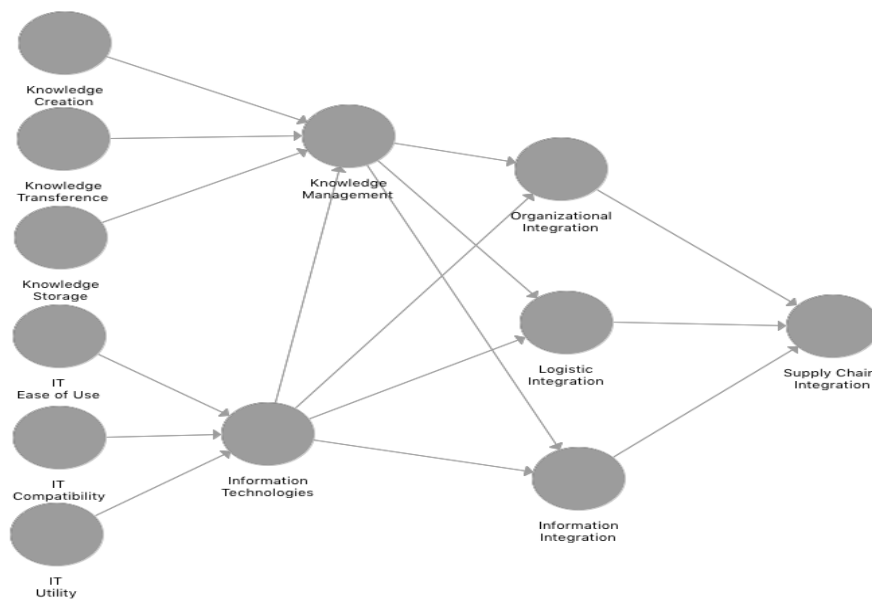


Fig1. Proposed supply chain integration model

4. Results and discussion

With the model components identified it was settled some hypotheses regarding the supply chain integration, the first hypothesis developed is that the IT utility, IT ease of use and IT compatibility influences positively the IT. The IT makes information visible, keeps firms in touch and facilitates decision-making and collaboration between supply chain participants, and also modifies competitive structures by reducing costs related to delivery times, inventories, reducing the whip-effect and production forecasts.

Also, IT acts as intermediaries in the exchange of information, so they are sought to be easy to use and any person can receive, interpret and use the information transferred. The IT must be compatible so that the information that is transmitted can enter



when it is needed and not have to use decoders to interpret the information. And finally, generate useful information for the firm that can be transferred to the entire supply chain and generate value.

The second hypothesis is that knowledge creation, knowledge storage, knowledge transference and IT influences positively on knowledge management. The knowledge creation involves great coordination between supply chain members and must be committed and open to interchange information, processes, and financial and human resources to develop new knowledge. Knowledge creation in the supply chain seeks to strengthen the relationship between partners.

The transfer of knowledge translated in terms of information flows, materials and money, implies the development of IT that facilitate availability, interpretation and decision-making within the firm, these decisions will have repercussions on the value thrown to the client. This point also involves great coordination among the participants in the supply chain. So that the knowledge created, stored and transferred can finally be executed by the firms in the supply chain, the development of information technologies that improve those activities have become necessary.

The third hypothesis establishes that both knowledge management and IT positively influence organizational integration, logistical integration and the integration of information.

Finally, the fourth hypothesis was developed. In this sense, organizational integration, logistical integration and information integration have a positive influence on the integration of the supply chain.

The conceptual model developed proposes that the compatibility, ease of use and usefulness of IT positively influence the use of IT in the supply chain. Likewise, information technologies have a positive influence on knowledge management and both influence the integration of information, organizational integration and the integration of information. Finally, these three elements influence the integration of the supply chain.

5. Conclusions

The main objective for supply chain integration is to reduce the barriers between the members of the supply partners, these barriers could be communication, information sharing, logistics, or knowledge. This model develops how knowledge and information technologies influence the three components of supply chain integration, the logistics integration, the information integration and the organizational integration and these on the general supply chain integration.



Joint knowledge management between supply chain members can increase sustained competitive advantages for the firms. To develop this knowledge management is necessary to improve in all the firms innovation to create knowledge, knowledge repositories to keep created knowledge and mechanism to safely knowledge transfer between all the participants in the supply chain.

In supply chain integration the role of information technologies also has a main job, nowadays real time information exchange is made by internet and processing software, so to reach supply chain integration the firms must have compatible software and real time connectivity, this is important because when information come all the supply chain member can make better decisions about production, forecasting, strategic planning and resources assignment.

With the theoretical model developed an important task is to test empirically using a structural equation model (SEMPLS or CBSEM) or another statistical technique to know how information technologies and knowledge management influences supply chain integration. To test this model a questionnaire must be developed and a universe of study must be identified. This is a suggestion for future research.

When the model tested empirically tested and the results discussed, the model can help firms to increase their supply chain integration with clients and suppliers and reduce the cost related to these activities such as the whip-effect, misunderstanding of information, high logistics costs regarding time, deliveries or IT incompatibilities.

Another suggestion is to add more variables that firms have such as total quality management, innovation management, strategic planning, or production management and also test the impact they have to improve the supply chain integration and design strategies and better practices among the firms involved in a supply chain.

References

- Akkermans, H., Bogerd, P., & Vos, B. (1999). Virtuous and vicious cycles on the road towards international supply chain management. *International Journal of Operations & Production Management*, 19(5/6), 565-581.
- Awad, H., & Nassar, M. (2010). Supply Chain Integration: Definition and Challenges. *Proceedings of the International MultiConference of Engineers and Computers Scientist*. Hong Kong: IMECS.
- Bagchi, P., & Skjoett-Larsen, T. (2002). Integration of Information Technology and Organizations in a Supply Chain. *The International Journal of Logistics Management*, 2(16), 89-108.
- Bagchi, P., Chun Ha, B., Skjoett-Larsen, T., & Sorensen, L. (2005). Supply chain integration: a European survey. *The International Journal of Logistics Management*, 16(2), 275-294.
- Ballou, R. (2004). *Logística: Administración de la cadena de suministro*. México: Pearson.

- Barney, J. B. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 99-120.
- Barney, J. B. (2012). Purchasing, Supply Chain Management, and Sustained Competitive Advantage: The Relevance of Resource-based theory. *Journal of Supply Chain Management*, 48(2), 3-6.
- Blome, C., Schoenherr, T., & Eckstein, D. (2014). The impact of knowledge transfer and complexity on supply chain flexibility: A knowledge-based view. *International Journal of Production Economics*, 147(B), 307-316.
- Cai, Z., Huang, Q., Liu, H., & Liang, L. (2016). The moderating role of information technology capability in the relationship between supply chain collaboration and organizational responsiveness: Evidence from China. *International Journal of Operations & Production Management*, 36(10), 1247-1271.
- Carter, P., Monczka, R., Ragatz, G., & Jennings, P. (2009). Supply Chain Integration: Challenges and Good Practices. Phoenix, Az. CAPS Research.
- Cassivi, L. (2006). Collaboration planning in a supply chain. *Supply Chain Management: An International Journal*, 11(3), 249-258.
- Chen, H., Daugherty, P. J., & Landry, T. D. (2009). Supply Chain process integration: a theoretical framework. *Journal of Business Logistics*, 30(2), 27-46.
- Coulson-Thomas, C. (2004). The knowledge entrepreneurship challenge: moving on from knowledge sharing to knowledge creation and exploitation. *The Learning Organization*, 11(1), 84-93.
- Craighead, C. W., Hult, G., & Ketchen, D. (2009). The effects of innovation-cost strategy, knowledge, and action in the supply chain on firm performance. *Journal of Operations Management*, 27(5), 405-421.
- Croom, S., Romano, P., & Giannakis, M. (2000). Supply Chain Management: an analytical framework for critical literature review. *European Journal of Purchasing & Supply Management*, 6, 67-83.
- De Vita, G., Tekaya, A., & Wang, C. (2011). The Many Faces of Asset Specificity: A Critical Review of Key Theoretical Perspectives. *The International Journal of Management Reviews*, 13(4), 329-348.
- Done, A. (2011). Supply Chain Knowledge Management: a Conceptual Framework. University of Navarra, IESE Business School. Barcelona: IESE Business School.
- Fabbe-Costes, N., & Jahre, M. (2008). Supply chain integration and performance: a review of the evidence. *The International Journal of Logistics Management*, 19(2), 130-154.
- Flynn, B. B., Huo, B., & Zhao, X. (2010). The Impact of Supply Chain Integration on Performance: A Contingency and Configuration Approach. *Journal of Operations Management*, 28(1), 58-71.
- Frohlich, M., & Westbrook, R. (2001). Arcs of integration: an international study of supply chain strategies. *Journal of Operations Management*, 19(2), 185-200.
- Hadaya, P., & Cassivi, L. (2009). Collaborative e-product development and product innovation in a demand-driven network: the moderating role of eCRM. *Electronic Markets*, 19(2-3), 71-87.
- Handfield, R., & Nichols, E. (1999). Introduction to supply chain management. Englewood Cliffs, NJ: Prentice-Hall.
- Hansen, M. T. (2002). Knowledge networks: Explaining effective knowledge sharing in multiunit companies. *Organization Science* (13), 232-249.
- Hult, G. T., Ketchen Jr., D., & Slater, S. (2004). Information processing, knowledge development, and strategic supply chain performance. *Academy of Management Journal*, 47(2), 241-253.

- Hult, G. T., Ketchen Jr., D., Cavusgil, S., & Calantone, R. (2005). Knowledge as a strategic resource in supply chains. *Journal of Operations Management*, 24, 458-475.
- Kaufman, R. (1997). Nobody Wins Until the Consumer Says, 'I'll Take It'. *Apparel Industry Management*, 58(2), 14-16.
- Ke, W., & Wei, K. (2008). Trust and Power Influences in Supply Chain Collaboration. In C. Tang, C. Teo, & K. Wei, *Supply Chain Analysis* (pp. 223-239). Boston, MA.: Springer.
- Kong, F., Ming, X., Wang, L., Wang, P., Zuo, H., & He, L. (2011). An integrated modularity approach for green product development. *International Journal of Environmental Technology and Management*, 14(5/6), 397-417.
- Koufteros, X., Rawski, G., & Rupak, R. (2010). Organizational integration for product development: the effects on glitches, on-time execution of engineering change orders, and market success. *Decision Sciences*, 41(1), 132-144.
- Kwon, I., & Suh, T. (2005). Trust, Commitment and Relationships in Supply Chain Management: a path analysis. *Supply Chain Management: An International Journal*, 10(1), 26-33.
- Lambert, D., & Pohlen, T. (2001). Supply Chain Metrics. *The International Journal of Logistics Management*, 1-19.
- Lambert, D., Cooper, M., & Pagh, J. (1997). Supply Chain Management: More Than a New Name for Logistics. *The International Journal of Logistics Management*, 8(1), 1-19.
- Lambert, D., Cooper, M., & Pagh, J. (1998). Supply Chain Management: Implementation Issues and Research. *The International Journal of Logistics Management*, 9(2), 1-19.
- Lee, C., Kwon, I., & Severance, D. (2007). Relationship between supply chain performance and degree of linkage among supplier, internal integration, and customer. *Supply Chain Management: An International Journal*, 12(6), 444-452.
- Lee, H. (2000). Creating value through supply chain integration. *Supply Chain Management Review*, 4(4), 30-36.
- Levary, R. (2000). Better supply chains through information technology. *Industrial Management*, 42(3), 629-644.
- Malhotra, A., Gosain, S., & El Sawy, O. (2005). Absorptive Capacity Configurations in Supply Chains: Gearing for Partner-Enabled Market Knowledge Creation. *MIS Quarterly*, 29(1), 145-187.
- Miraz, M., Habib, M., & Molla, M. (2016). An overview of information technology tools implementation in supply chain management. *IETI Transactions on Computers*, 2(2), 110-117.
- Narasimhan, R., & Kim, S. (2001). Information system utilization strategy for supply chain integration. *Journal of Business Logistics*, 22(2), 51-75.
- Narasimhan, R., & Kim, S. (2002). Effect of supply chain integration on the relationship between diversification and performance: evidence from Japanese and Korean firms. *Journal of Operations Management*, 20(3), 303-323.
- Nelson, K., & McCann, J. (2010). Designing for knowledge worker retention & organization performance. *Journal of Management and Marketing Research*.
- Power, D. (2005). Supply Chain Management Integration and Implementation: a Literature Review. *Supply Chain Management: An International Journal*, 252-263.
- Prajogo, D., & Olhager, J. (2012). Supply Chain Integration and Performance. The Effects of Long-term relationships, Information Technology and Sharing, and Logistics Integration. *International Journal of Production Economics*, 135(1), 514-522.
- Rai, A., Patanayakuni, R., & Seth, N. (2006). Firm Performance Impacts of Digitally Enabled Supply Chain Integration Capabilities. *MIS Quarterly*, 30(2), 225-246.



- Rosenzweig, E., Roth, A., & Dean Jr., J. (2003). The influence of an integration strategy on competitive capabilities and business performance: An exploratory study of consumer products manufacturers. *Journal of Operations Management*, 21(4), 437-456.
- Simichi-Levi, D., Kaminsky, P., & Simichi-Levi, E. (2003). Designing and managing the supply chain: Concepts, strategies and case studies. New York: McGraw Hill.
- Stock, J., & Boyer, S. (2009). Developing a Consensus Definition of Supply Chain Management: a Qualitative Study. *International Journal of Physical Distribution & Logistics Management*, 690-711.
- Van der Vaart, T., & Van Donk, D. (2008). A critical review of survey-based research in supply chain integration. *International Journal of Production Economics*, (111), 42-55.
- Vanpoucke, E., Vereecke, A., & Muylle, S. (2017). Leveraging the impact of supply chain integration through information technology. *International Journal of Operations and Production Management*, 37(4), 510-530.
- Walsh, J., & Ungson, G. (1991). Organizational memory. *Academy of Management Review*, 16(1), 57-91.
- Wang, M., Liu, J., Wang, H., Cheung, W., & Xie, X. (2008). On-demand e-supply chain integration: A multi-agent constraint-based approach. *Expert Systems with Applications*, 2683-2692.
- Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, 5(2), 171-180.
- Zhang, M., & Huo, B. (2013). The Impact of Dependence and Trust on Supply Chain Integration. *International Journal of Physical Distribution and Logistics Management*, 43(7), 544-563.